GM-22

MINERAL RESOURCE MAPS OF WASHINGTON

BY

WAYNE S. MOEN

ENERGY RESOURCES

METALLIC MINERALS

NONMETALLIC MINERALS

PITS AND QUARRIES

These 4 million-scale maps show locations metallic and nonmetallic minerals, coal fiel sand and gravel pits, stone quarries, and ar of potential oil and gas and geothermal sources. Over 500 metallic and nonmetallic posits and almost 450 pits and quarries shown.

GM-22

1978

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Division of Geology and Earth Resources

TO ACCOMPANY
GM-22

MINERAL RESOURCE MAPS OF WASHINGTON

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INTRODUCTION

These 4 mineral resource maps of Washington are the outgrowth of continued demand for maps showing the distribution of the state's mineral and energy resources. Prior to the publication of these maps no single map, at a reasonable scale, was available that showed the overall distribution of the different mineral resources.

One of the best known sources of mineral maps is in Washington Division of Geology and Earth Resources Bulletin 37, "Inventory of Washington Minerals." This two-part bulletin contains 65 separate maps, at a scale of 1 inch to 25 miles, which shows the locations of most of the state's metallic and nonmetallic minerals. This bulletin was used extensively in the compilation of the new mineral resource maps.

Mineral resources of Washington also appear in "Mineral and Water Resources of Washington" (U.S. Geological Survey, 1966). Many mineral occurrences in this report are shown on 35 maps at a scale of 1 inch to 60 miles; however, this publication is no longer in print and is out of reach to most people. Many other maps, at a wide variety of scales, may be found in a large number of geologic publications; however, very few of these maps are intended to show the overall distribution of the state's mineral and energy resources.

The four new mineral and energy resource (million-scale) maps show locations of metallic and nonmetallic minerals, coal fields, sand and gravel pits, stone quarries, exploratory oil and gas wells, thermal springs, and areas of potential oil and gas and geothermal resources. Over 500 metallic and nonmetallic occurrences and about 470 pits and quarries are shown. For convenience of use, the mineral and energy resource data appear on four sheets as follows:

Sheet 1—Metallic mineral resources
Sheet 2—Nonmetallic mineral resources
Sheet 3—Sand and gravel pits and stone quarries
Sheet 4—Energy resources

As can be seen from the maps, every county in Washington contains minerals of one type or other. Sand, gravel, and stone are widespread and may be found in almost every county. For the most part, metallic occurrences are confined to mountainous regions, whereas deposits of coal and potential oil and gas areas are confined chiefly to the lowland area of the Puget Lowlands of western Washington.

In no way are the mineral and energy resource maps intended to show every occurrence in the state for it would be impossible on million-scale maps to plot all mineral occurrences. I have, however, attempted to show all past and present mineral producers, as well as mineral deposits that have yet to be exploited. In doing so I believe that the maps present a fairly accurate picture of the distribution of minerals and energy resources in Washington. Several excellent publications were used in compiling the data shown on the maps. For the benefit of individuals who seek more information on the mineral and energy resources, these publications are cited in the discussion that follows.

MAP SHEET 1—METALLIC MINERALS

Over 3,000 occurrences, which contain one or more of 31 different metals, are present in Washington. Of the 31 metals, 17 have been produced in the past, or appear to be present in significant amounts; these metals, which are represented by about 500 occurrences, are shown on sheet 1. As can be seen on the map sheet, the occurrences are not randomly distributed throughout the state, but are grouped into definite areas that, for the most part, fall in the mountainous regions of the state. In the northeastern part of the state, the metal occurrences are mainly in the Okanogan Highlands physiographic province. In the central part of the state, they occur mainly in the Cascade Mountains province, which extends from the Canadian border to the Columbia River. In the far western part of the state, metals occur mainly in the Olympic Mountains province. Geologically, the metal occurrences appear to be related chiefly to igneous rocks. Base and precious metals deposits predominate in the Okanogan Highlands and Cascade Mountains provinces and coincide with granitic rocks. In the Olympic Mountains province, manganese predominates and coincides with volcanic rocks that border the metasedimentary core of the Olympics.

References

Huntting, M. T., 1956, Inventory of Washington minerals, Part 2, Metallic minerals: Washington Division of Mines and Geology Bulletin 37, v. 1, 428 p., v. 2, 67 p.

United States Geological Survey, 1966, Mineral and water resources of Washington: Washington Division of Mines and Geology Reprint 9, 436 p.

MAP SHEET 2—NONMETALLIC MINERALS

Washington contains a variety of nonmetallic minerals that are distributed over a wider area of the state than the metallic minerals. As can be seen from map sheet 2, most counties contain one or more occurrences of nonmetallic minerals. About 50 nonmetallic minerals are present at over 3,500 localities. Of these 50 minerals, 27 have been mined or are present in significant amounts; these occurrences appear on sheet 2. This does not include stone quarries for which rock is mined for concrete and bitumen aggregate or road ballast. Unlike metallic minerals that appear to be related mainly to igneous rocks, the nonmetallic minerals occur in almost all rock types found in Washington. Whereas on the average of only four metal mines in recent years were major full-time operating mines, upward of 35 nonmetallic properties operate yearly in Washington.

References

Valentine, G. M., 1960, Inventory of Washington minerals, Part 1, Nonmetallic minerals, 2nd edition, revised by Marshall T. Huntting: Washington Division of Mines and Geology Bulletin 37, v. 1, 175 p., v. 2, 83 p.

United States Geological Survey, 1966, Mineral and water resources of Washington: Washington Division of Mines and Geology Reprint 9, 436 p.

MAP SHEET 3—SAND AND GRAVEL PITS AND STONE QUARRIES

Almost every county in the state contains commercial deposits of sand, gravel, and stone. As such, these materials represent the state's major mineral products. In 1977, around 120 stone quarries and over 350 sand and gravel pits were in operation. As can be seen on map sheet 3, the bulk of the sand and gravel and stone operations occur in the populous regions of the state where great amounts of these materials are required for construction purposes. Although extensive deposits of sand, gravel, and stone occur elsewhere in the state, high freight rates make it im-

practical to transport these low-cost materials over great distances.

Sand and gravel in Washington is mainly of glacial origin, having been formed as glacial moraines or as outwash material from continental and alpine glaciers. In general, the best deposits occur in the Puget Lowlands or in valleys where the valley is wide enough and has moderate to low grades that permit accumulation. In short narrow steep-graded valleys, few significant deposits of sand and gravel can be found.

Vast areas of the state contain deposits of stone but as in the case of sand and gravel, the low cost of stone requires that the quarries be as near as possible to existing markets. Roughly 60 percent of the stone quarried in Washington for aggregate and road ballast consists of basalt and andesite.

References

Valentine, G. M., 1960, Inventory of Washington minerals, Part 1, Nonmetallic minerals, 2nd edition, revised by Marshall T. Huntting: Washington Division of Mines and Geology Bulletin 37, v. 1, 175 p., v. 2, 83 p.

Milne, Clint; Walker, C. W., 1978, Directory of Washington mining operations, 1977: Washington Division of Geology and Earth Resources Information Circular 62 (in print).

Moen, W. S., 1967, Building stone of Washington: Washington Division of Mines and Geology Bulletin 55, 85 p.

MAP SHEET 4—ENERGY RESOURCES

The energy resource map of Washington shows locations of coal fields, limits of coal-bearing rocks, areas favorable for the occurrence of oil and gas, exploratory oil and gas wells, thermal springs, and areas of geothermal potential. Washington's greatest energy resource—hydro—is not shown. Uranium, which is also an energy resource, appears on sheet 1, "Metallic minerals of Washington."

As can be seen on map sheet 4, most of the state's coal fields, as well as areas of potential oil and gas, occur in western Washington in areas underlain by sedimentary rocks. With the exception of coal that is being mined in the Centralia-Chehalis coal field, mining of coal in most parts of Washington is at a standstill. Although many exploratory oil and gas wells have been drilled in the state since 1900, the Medina No. 1 well north of Grays Harbor is the only oil well that produced on a subcommercial basis. Offshore exploration in the future may result in significant oil and gas discoveries.

Geothermal resources of Washington have yet to be developed. Several thermal springs, where water temperature exceeds 20 degrees Centigrade, have or are being used as spas; however, surface temperatures of the springs are not great enough to be converted into energy. Five areas, which coincide with the state's major volcanoes, represent areas of recently active stratovolcanoes, fumaroles, and(or) hot springs. These areas appear to be the most favorable areas in the state for geothermal resources.

References

Beikman, H. M.; and others, 1961, Coal reserves of Washington: Washington Division of Mines and Geology Bulletin 47, 115 p.

Washington Division of Geology and Earth Resources; and others, 1974, Energy Resources of Washington: Washington Division of Geology and Earth Resources Information Circular 50, 158 p.

Livingston, V. E., Jr., 1958, Oil and gas exploration in Washington 1900-1957: Washington Division of Mines and Geology Information Circular 29, 61 p.

SUMMARY

Washington is fortunate in having a wide variety of mineral resources that support the overall economy of the state. Through the years the use of our valuable raw materials has been steadily increasing, keeping pace with the ever-rising standard of living and increasing growth. Everything we do and all our industries, in some way or another, are tied into the mineral industry. We must have sand and gravel to build homes, metals obtained from ores for manufacturing automobiles and for other industrial uses, crushed rock for road paving, various minerals for medicinal and other chemical uses, and so forth. If one were to try to list all the uses minerals have, the list would be endless, because new uses are being developed every day.

The mineral deposits, which are so necessary to our existence, were formed on the surface of, and deep within, the earth by slow natural processes during the long geologic past. Most of the valuable minerals occur in small isolated deposits and, of course, are found only where they formed. Because mineral deposits are nonrenewable and cannot be grown like crops—nor can they be shifted from one location to another—it is important to keep potential mineral-producing areas open to prospecting and possible future production. As our population increases, the demand for mineral products of course will increase also. It is in the interest of every citizen of the state to make sure that land-management practices are such that maximum use of our mineral resources will be possible. It should be kept in mind that a mine, stone quarry, or gravel pit is a temporary thing. As soon as the deposit is depleted, the land is available or can be reclaimed for other uses. Examples are the abandoned coal strip mines of the Middle West that have been reclaimed as lakes and parks. In our own state, the old Holden mining property has been converted to an attractive summer retreat for religious groups and gravel pits have been transformed into recreational lakes.

WASHINGTON DEPARTMENT OF NATURAL RESOURCES
DIVISION OF GEOLOGY AND EARTH RESOURCES

METALLIC MINERAL RESOURCE MAP OF WASHINGTON

BY
W.S. MOEN

SCALE 1:1,000,000
10 0 10 20 30 40 MILES

1978

LEGEND

Precious metals group		Base metals group		Iron alloys group		Miscellaneous metals group	
Gold	Au	Copper	Cu	Iron	Fe	Uranium	U
Silver	Ag	Molybdenum	Mo	Nickel	Ni	Mercury	Hg
		Lead	Pb	Chromium	Cr	Tin	Sn
		Zinc	Zn	Manganese	Mn	Tungsten	W
		Lead-zinc	L-Z	Titanium	Ti	Antimony	Sb

Current or recent producer

Past producer or significant deposit

WASHINGTON DEPARTMENT OF NATURAL RESOURCES
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NONMETALLIC MINERAL RESOURCE MAP OF WASHINGTON

BY
W.S. MOEN

SCALE 1:1,000,000
10 0 10 20 30 40 MILES

1978

LEGEND

Massive consolidated deposits		Semiconsolidated deposits		Vein and disseminated deposits		Mineral water and brine	
Dolomite	Dl	Alunite	Al	Andalusite-kyanite	An	Mineral water	Mw
Granite	Gr	Bauxite	Bx	Barite	Ba	Brine with salts	Sc
Limestone	Lm	Clay	Cl	Beryl	Be		
Magnesite	Mg	Diatomite	Di	Feldspar	Fel		
Olivine	Ol	Gypsum	Gy	Fluorite	Fl		
Quartz	Si	Peat	Pt	Garnet	Gt		
Quartzite	Qz	Pumice-pumicite	Pu	Jade	J		
Serpentine	Sp	Silica sand	Ss	Strontium	St		
Talc	Ta						

Current or recent producer

Past producer or significant deposit

Note: Crushed and broken stone shown on sheet 3, "Sand and gravel pits and stone quarries of Washington."

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MINERAL RESOURCE MAPS OF WASHINGTON GM-22
Sheet 3 of 4 map sheets
Sand and gravel pits and stone quarries

SAND AND GRAVEL PITS AND STONE QUARRIES OF WASHINGTON

BY
W.S. MOEN

SCALE 1:1,000,000

10 0 10 20 30 40 MILES

1978

LEGEND

- Sand and gravel pit
- Stone quarry

Stone quarry symbols

Andesite	An	Olivine	Ol
Basalt	Ba	Phyllite	Ph
Diorite	Dr	Quartzite	Qz
Dolomite	Dl	Sandstone	Ss
Felsite	Fs	Shale	Sh
Granite	Gr	Silica	Si
Limestone	Lm		

Note: See sheet 2, "Nonmetallic mineral resources of Washington" for other stone occurrences.

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MINERAL RESOURCE MAPS OF WASHINGTON GM-22
Sheet 4 of 4 map sheets
Energy Resources

ENERGY RESOURCE MAP OF WASHINGTON

BY
W. S. MOEN

SCALE 1:1,000,000
10 0 10 20 30 40 MILES

1978

Whatcom Basin
Hamilton
Mc Murray
Issaquah
Green River
Cle Elum - Roslyn
Wilkeson - Carbonado
Toneum
Fairfax - Ashford
Centralia - Chehalis
Eastern Lewis County
Kelso - Castle Rock

Mt. Baker
Glacier Pk.
Mt. Rainier
Mt. St. Helens
Mt. Adams

LEGEND

Geothermal
- Area of recently active stratovolcanoes, fumaroles, and(or) thermal springs
- Thermal spring with temperature in excess of 20° Centigrade (68°F.)

Coal
- Anthracite
- Bituminous
- Subbituminous
- Lignite
- Areas with reserves
- Limit of coal-bearing rocks with name of field
- Isolated occurrence
- Operating mine

Oil and gas
- Areas considered favorable for occurrence of oil and gas
- Exploratory oil and gas well
- Oil well with record of production
- Gas well with record of production
- Natural gas storage area

Note: Areas of coal-bearing rocks in western Washington also considered favorable for occurrence of oil and gas.